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Specification

Guiding Elements for a Strip-Producing or Strip-Processing Machine

The invention relates to guide elements, in particular turning bars, of a web-producing or web-processing machine in accordance with the preamble of claim 1, 2, 5 or 6.

A web guide element designed as a turning bar is known from DE 93 20 281 U1, which can be brought into at least two angled position in relation to an incoming web. In the course of pivoting from a first into the other position, openings of an inner body are displaced in respect to openings in an outer body of the turning bar in such a way that the air outlet openings which are not needed are closed.

A turning bar is disclosed in one exemplary embodiment of USP 3,744,693, in which a tube wall segment made of a porous, air-permeable material, together with a base body, constitutes a closed pressure chamber. The porous segment constitutes a wall of the chamber and is embodied to be load-bearing over the width thereof - without a load-bearing support -. In a second example, a segment with penetration bores is arranged in place of the porous segment.

USP 5,423,468 shows a guide element which has an inner body with bores and an outer body of a porous, air-permeable material. The bores in the inner body are only provided in the area which is expected to be looped.

The object of the invention is based on producing guide elements which are flexible in connection with the change of direction of a web and are simple to produce.

In accordance with the invention, this object is attained by means of the characteristics of claims 1, 2. 5 or 6.

The advantages to be gained by means of the invention consist in particular in that a guide element which can be flexibly inclined in respect to the web is created without a large structural outlay, which is distinguished by an air cushion of a large degree of homogeneity with simultaneously small losses.

By means of conventional openings, forces can be applied point-by-point to the material (impulse of the jet), by means of which the latter can be kept away from the respective component, or placed against another component, while, by means of the distribution of micro-openings with a high hole density, a broad support and, as a matter of priority, the effect of a formed air cushion, is applied. The cross section of bores used up to now lay for example in the range between 1 and 3 mm, while the cross section of the micro-openings is smaller by at least the power of ten. Because of this, substantially different effects arise. For example, the distance between the surface with the openings and the web can be reduced, the flow volume of flow means can drop considerably and by means of this, flow losses which possibly occur outside of the areas which act together with the web can be clearly reduced.

In contrast to known components with conventional openings, or bores, a greatly more homogeneous surface is created with the formation of micro-openings on the surface with opening cross sections in the millimeter range and a hole distance of several millimeters. Here, micro-openings

are understood to be openings in the surface of the component which have a diameter of less than or equal to 500 μm, advantageously less than or equal to 300 μm, in particular less than or equal to 150 μm. A "hole density" of the surface provided with micro-openings is at least one micro-opening per 5 mm² (=0.20/mm²), advantageously at least one micro-opening per 3.6 mm² (= 0.28/mm²).

The air cushion is homogenized by designing the openings as micro-openings, and the volume flow exiting per unit of area can be reduced in such a way that a flow loss can be negligibly small even in the areas around which the web does not loop.

The micro-openings can be advantageously designed as open pores at the surface of a porous, in particular micro-porous, air-permeable material, or as openings of penetrating bores of small diameter, which extend through the wall of a supply chamber toward the exterior. Although the following exemplary embodiments primarily show the guide element in an embodiment with a porous material, the embodiment with penetrating bores is to be applied in the same way to the principle of pivotable turning bars represented there.

In order to achieve a uniform distribution of air exiting from the surface in the case of employing micro-porous material, without requiring at the same time large layer thicknesses of the material with high flow resistance, it is useful for the component to have a rigid air-permeable support, to which the micro-porous material has been applied as a layer. Such a support can be charged with compressed air, which flows out of the support through the micro-porous

layer and in this way forms an air cushion on the surface of the component.

The support itself can be porous and have a better air permeability than the micro-porous material, but it can also be formed of a flat material or shaped material which encloses a hollow space and is provided with air outlet openings. Combinations of these alternatives can also be considered.

For achieving a uniform air distribution it is moreover desirable that the thickness of the layer correspond to at least the distance between adjoining openings.

In case of using micro-bores, an embodiment is advantageous, wherein the side of the guide element which faces the web and has the micro-openings is embodied as an insert or as several inserts in a support. In a further development, the insert can be releasably or, if desired, exchangeably connected with the support. In this way cleaning and/or an exchange of inserts with different micro-perforations for adaptation to different materials, web tensions, number of layers in the strand and/or partial web widths is possible.

Exemplary embodiments of the invention are represented in the drawings and will be described in greater detail in what follows.

Shown are in:

Fig. 1, a schematic representation of the turning bar in a first, a), and a second, b), position,

Fig. 2, a perspective, partially broken open section through the turning bar with a support and a coating with

porous material around the entire circumference,

Fig. 3, a perspective section through the turning bar with micro-bores arranged over the entire circumference,

Fig. 4, a schematic representation of a pivotable turning bar in a different embodiment,

Fig. 5, a section through a turning bar in accordance with Fig. 4.

A guide element 01, for example web guide element 01, is used in a web-producing or -processing machine, for example a paper-making machine, winding machine, packaging machine, or in particular printing press, for guiding, or for a change in direction of a web 02 , for example web 02 of material, or web 02 of material to be imprinted, which runs over the guide element 01. In particular, the guide element 01 is embodied as a turning bar 01, by means of which - depending on its position relative to the direction of the incoming or running-up web 02 - a change in direction by approximately +90° or approximately -90° is provided for the web 02 by being looped around the turning bar 01. In the form of a pair of two parallel turning bars 01 inclined by 45° in respect to the web transport direction, the turning bar 01 can be used for a lateral offset or, for tipping the web 01, as a pair of turning bars 01, which cross each other and are inclined by 45° or -45° in respect to the web transport direction . Several pairs of turning bars are advantageously arranged.

The turning bar 01, or the pair of turning bars, can be arranged downstream of a printing group and upstream of a folding apparatus, or downstream of a dryer and upstream of a folding apparatus, of a rotary printing press. It has an

exterior diameter of 60 to 100 mm, for example, and a length of more than 1,200 mm, for example. In this case the turning bar 01 has (or each of both turning bars 01) at least two positions and is (or are) pivotable over 90° in particular, wherein in a first position a web 02 is looped around a first half of the surface area (Fig. 1a), and a second half of the surface area is being looped in a second position (Fig. 1b).

The surface area of the turning bar 01 has openings 03, for example micro-openings 03, through which a fluid, for example a liquid, a gas or a mixture, in particular air, which is under higher pressure than the surroundings, flows from the hollow space 04, for example a chamber 04, in particular a pressure chamber 04, during the operation. An appropriate feed line for compressed air into the hollow space 04 is not represented in the drawings.

The turning bar 01 has micro-openings 03 in its surface area in the circumferential direction on the side which is looped around in the respective operating situation, as well as in the side not covered by the web 02, i.e. the side facing away from it. Therefore the turning bar 01 has micro-openings 03 distributed over the full circumference of 360° (facing, as well as facing-away side) at least on its longitudinal section intended for being looped. In a preferred embodiment, no device or mechanism is provided for the turning bar 01 which, during the operation, would stop the flow of the fluid from the hollow chamber 04 through the micro-openings 03 on the side facing away from the web 02. This means that in each one of the at least two mentioned operating positions the micro-openings 03 a fluid can be, or is, flowing in a complete circumferential area of 360°. The

change of position of the turning bar 01 from one into the other position only requires pivoting but no complete covering of the openings, or interruption of the passage between the hollow chamber 04 and micro-opening 03.

This simple embodiment becomes usefully possible by the design of the openings 03 as micro-openings 03, because a thinner, but homogeneous air cushion is created with this, and simultaneously a required, or resulting volume flow, and therefore also a flow loss over the "open" side, is considerably reduced. In contrast to openings of large diameter, the large resistance of the micro-openings 03 does not cause the "non-covering" of an area of the openings to result in a sort of short-circuit flow. The partial resistance falling off via the openings 03 has an increased weight in the total resistance.

In a first embodiment, the micro-openings 03 are embodied as open pores on the surface of a porous, in particular micro-porous, air-permeable material 06, for example an open-pored sinter material 06, in particular a sinter metal. The pores of the air-permeable porous material 06 have a mean diameter (mean size) of less than 150 μm, for example 5 to 60 μm, in particular 10 to 30 μm. The material 06 is designed with an irregular amorphous structure.

The choice of material, the dimensions and charging with pressure have been selected in such a way that 1 to 20 standard cubic meters per m² emerge from the air outlet surface of the sinter material 06 per hour, in particular 2 to 15 standard cubic meters per m². An air output of 3 to 7 standard cubic meters per m² is particularly advantageous.

The sinter surface is advantageously charged with excess pressure of at least 1 bar, in particular more than 4 bar, from the hollow space 04. A charge of the sinter surface with excess pressure of 5 to 7 bar is particularly advantageous.

If the hollow space 04 of the turning bar 01 is essentially only made of a body of porous solid material (i.e. without any further load-bearing layers), at least in its longitudinal area acting together with the web 01, this body, which has been designed to be tube-shaped, for example, is substantially embodied to be self-supporting, with a wall thickness of more than or equal to 2 mm, in particular more than or equal to 3 mm. If required, a support can run inside the hollow space 04, on which the body can be supported at points, or in areas, but which is not in active connection with the body over its full surface.

For achieving a uniform distribution of the air exiting at the surface of the micro-porous material 06, without requiring at the same time large layer thicknesses of the material 06 with a correspondingly high flow resistance, it is practical in an advantageous embodiment that the turning bar 01 has a solid support 07, which is air-permeable at least in part and to which the micro-porous material 06 has been applied as a layer 06 (Fig. 1). Such a support 07 can be charged with compressed air, which flows out of the support 07 through the micro-porous layer 06 and in this way forms an air cushion at the surface of the turning bar 01. In a particularly advantageous embodiment, the porous material 06 is therefore not embodied as a supporting solid body (with

or without a frame structure), but as a layer 06 on a, in particular metallic, support material, which has passages 08 or through-openings 08. A structure is understood to be the "non-supporting" layer 06 together with the support 07 - in contrast to, for example, the "supporting" layers known from the prior art -, wherein the layer 06 is supported over its entire layer length and entire layer width on a multitude of support points of the support 07. For example, over its width and length which is active together with the layer 06, the support 07 has a plurality of non-connected passages 08. This embodiment is clearly different from an embodiment in which a porous material extending over the entire width, which is active together with the web 02, is designed to be self-supporting over this distance, and is only supported in the end area on a frame or support, and therefore must have an appropriate thickness.

In the exemplary embodiment represented, the support material substantially absorbs the weight, shear, torsion, bending and/or shearing forces of the component, because of which an appropriate wall thickness (for example greater than 3 mm, in particular greater than 5 mm) of the support 07 and/or an appropriately reinforced construction have been selected. The support 07 which, for example, borders the hollow chamber 04 toward the layer 06, or constitutes the hollow chamber 04 by being appropriately shaped (for example tube-shaped), has on the side coated with the porous material a plurality of openings 09 for feeding the compressed air into the porous material 06. Porous material can also be partially contained in the openings 09 of the support 07 in the area of the walls.

The porous material 06 outside of the passage 08 has a layer thickness which is less than 1 mm. A layer thickness between 0.05 mm and 0.3 mm. is particularly advantageous. A proportion of the open face in the area of the effective outer surface of the porous material, here called degree of opening, lies between 3% and 30%, preferably between 10% and 25%. For achieving a uniform distribution of air, it is furthermore desirable for the thickness of the layer to correspond at least to the distance between adjoining openings 09 of the support 07.

The compressed air exiting the sinter material 06 emerges completely, i.e. substantially over 360°, in the circumferential direction in both positions of the turning bars.

In accordance with the embodiment represented in Fig. 2, a support tube 07 with an arbitrary profile, but preferably shaped as a circular ring, is arranged as the support 07, or inner body 07, in the turning bar 01, wherein the wall thickness of the support tube 07 is greater than 3 mm, in particular greater than 5 mm. The support tube 07 has a plurality of passages 08 with openings 09 for feeding compressed air into the porous material 06.

The support 07 which, if desired, is designed as a support tube 07, can itself also be made of a porous material, but with a better air permeability - for example a greater pore size - than that of the micro-porous material of the layer 06. In this case the openings of the support 07 are constituted by open pores in the area of the surface, and the passages 08 by channels which are incidentally formed in the interior because of the porosity. However, the support

07 can also be constituted by any arbitrary flat material enclosing the hollow space 04 and provided with passages 08, or by shaped material. Combinations of these alternatives can also be considered.

The interior cross section of a feed line, not represented, for supplying compressed air to the turning bar is less than 100 mm^2, it preferably lies between 10 and 60 mm^2.

In a second embodiment (Fig. 3), the micro-openings 03 are designed as openings of penetrating bores 11, in particular micro-bores 11, which extend outward through a wall 12, for example a chamber wall 12, bordering the hollow chamber 04 designed as a pressure chamber 04. The bores 11 have, for example, a diameter (at least in the area of the openings 03) of less than or equal to 500 μm, advantageously less than or equal to 300 μm, in particular between 60 and 150 μm. The degree of opening lies, for example, between 3% to 25%, in particular 5% to 15%. A hole density is at least 1 / 5 mm^2, in particular at least 1 / mm^2 up to 4 / mm^2. Therefore the wall 12 has a micro-perforation, at least in an area located opposite the web 02. In an advantageous manner, the micro-perforation - the same as the passages 08 and layer 06 in the first exemplary embodiment - extends over the full circumference of 360°.

A wall thickness of the chamber wall 12 containing the bores which, inter alia, affects the flow resistance, lies between 0.2 to 0.3 mm, advantageously between 0.2 to 1.5 mm, in particular between 0.3 to 0.8 mm. A reinforcing structure, not represented, for example a support extending in the longitudinal direction of the turning bar 01, in

particular a metal support, can be arranged in the interior of the turning bar 01, in particular in the hollow chamber 04, on which the chamber wall 12 is supported at least in part or at points.

The wall 12 enclosing the chamber 04 is embodied, for example, as a hollow profiled body, preferably a tube-shaped hollow profiled body, in particular a hollow profiled body with a circular-ring-shaped profile.

An excess pressure in the chamber 04 of maximally 2 bar, in particular of 0.1 to 1 bar, is of advantage for the embodiment of the micro-openings 03 as openings 03 of bores 11.

The bores 11 can be embodied cylindrical, funnel-shaped or in another special shape (for example in the form of a Laval nozzle).

The micro-perforation, i.e. producing the bores 11, preferably takes place by drilling by means of accelerated particles (for example a liquid, such as a water jet, ions or elementary particles), or by means of electromagnetic radiation of high energy density (for example light in the form of a laser beam). Producing by means of an electron beam is particularly advantageous.

The side of the wall 12 having the bores 11 and facing the web 02, for example a wall 12 made of special steel, in a preferred embodiment has a dirt- and/or ink-repelling finish. It has a non-represented coating - for example of nickel or advantageously chromium - which does not cover the openings 10 or bores 11, and which for example has been additionally treated - for example with micro-ribs or structured in a lotus flower-effect, or preferably polished to a high gloss).

In a variation, the wall with the bores is embodied as an insert or as several inserts in a support. The insert can be connected fixedly or exchangeably with the support. The latter is of advantage in respect to cleaning or an exchange of inserts with different micro-perforations for matching different materials and web widths. In the embodiment wherein the openings 03 are substantially arranged over the full surface, such inserts can be arranged on a support extending in the interior of the hollow space 04, for example.

In connection with a further example (Fig. 4) of a pivotable turning bar 01, several chambers 04 are arranged therein, wherein a portion of the surface area of the turning bar 01 (sinter area, as represented, or micro-perforated area, not represented) is assigned in the circumferential direction to each one of the chambers 04. Each chamber 04 can be selectively charged with compressed air, so that in every position the respectively looped area of the turning bar 01 is charged with compressed air. For this embodiment at least two feed lines 13, which can be selectively charged with compressed air, for example, are arranged on the turning bar 01, or the chambers 04 can be selectively charged via a multi-path valve with compressed air provided by a source (Fig. 5).

List of Reference Numerals

01	Guide element, web guide element, turning bar
02	Web, web of material, web of material to be imprinted, paper web
03	Opening, micro-opening
04	Hollow space, chamber, pressure chamber
05	-
06	Micro-porous material, sinter material, layer, micro-porous, coating
07	Support, inner body, support tube
08	Passage, through-opening
09	Opening
10	-
11	Bore, micro-bore
12	Wall, chamber wall
13	Feed line